
National Aeronautics and Space Adr
NASA
Data Sciences at NASA Ames
2017 Ames Machine Learning Workshop
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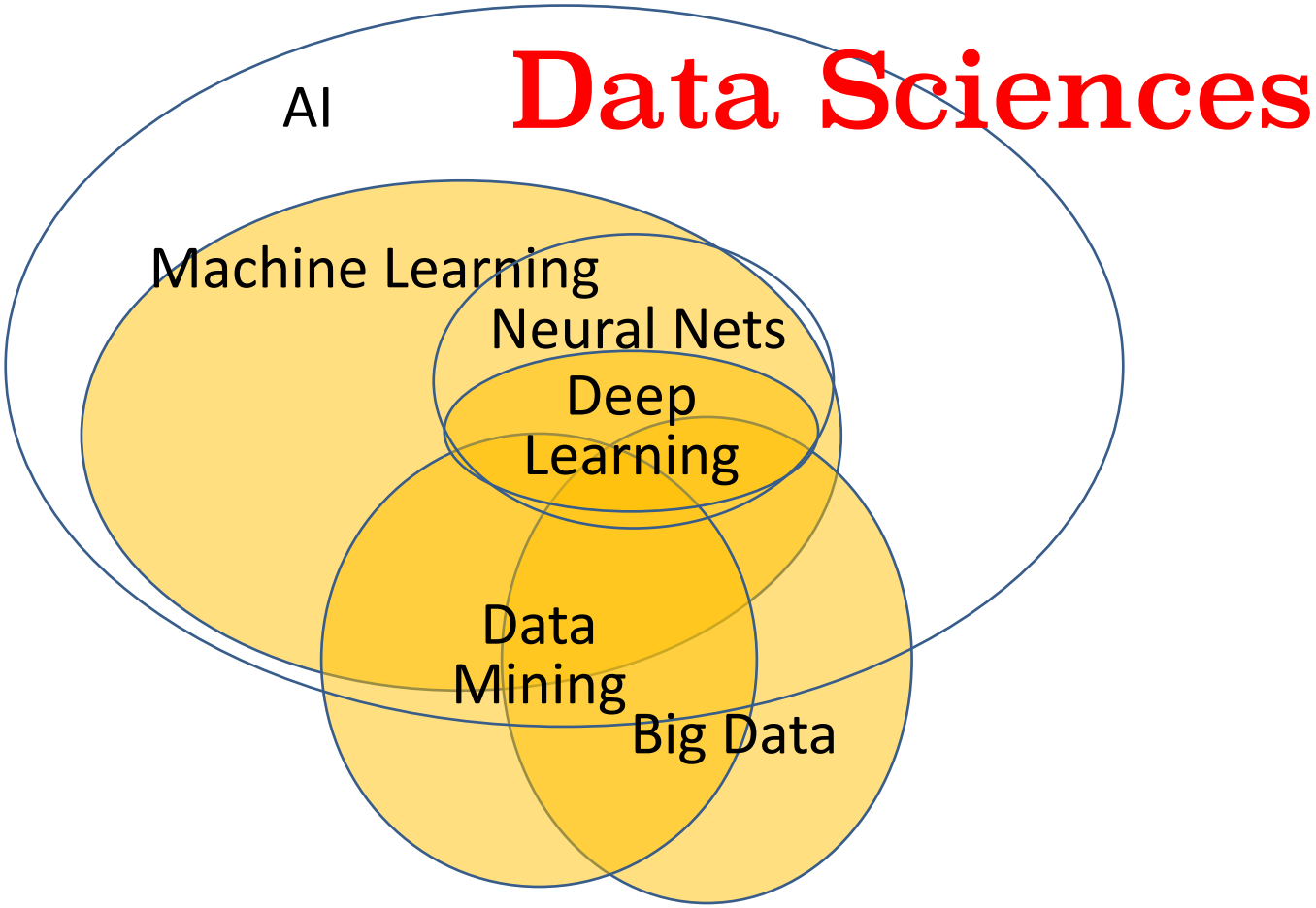
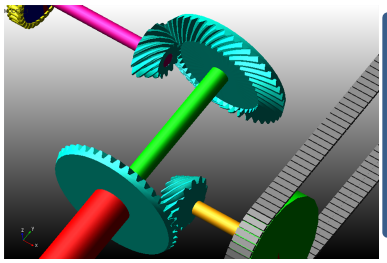
Outline

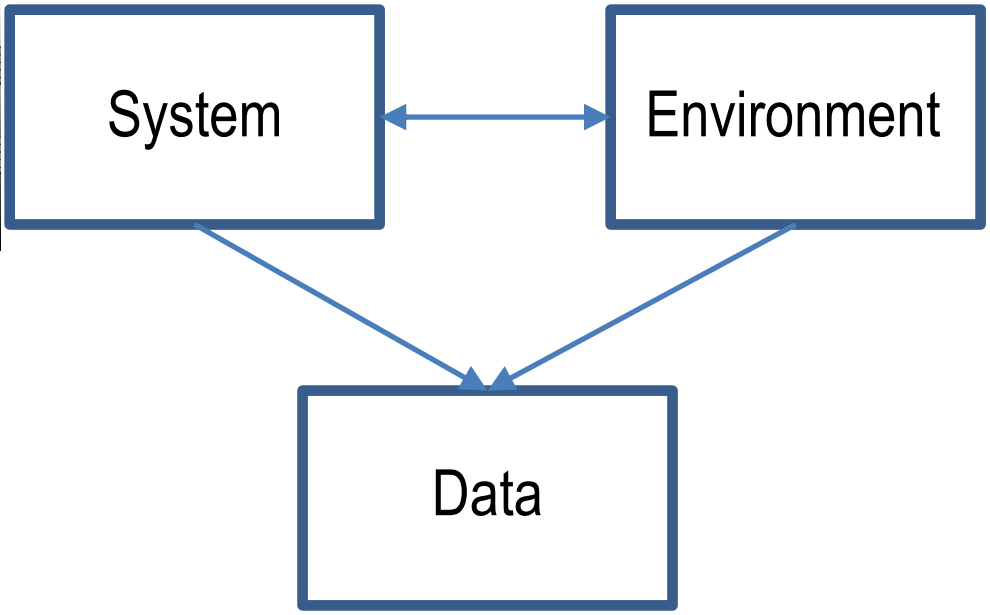
- What Is All This Stuff?
- 2017 Ames Machine Learning Workshop
- Data Sciences Group
- Collaborators

What is All This Stuff?



Machine Learning





- Data are produced by system operating in an environment
- Goal: Reverse-engineer system and environment from data
- Understand how system *really* works, correct system model errors, understand true impact of environment

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2017 Machine Learning Workshop

- What Machine Learning (ML) has done/can do for NASA problems
- What ML is/is not
  - Is: Difficult, Requires teamwork, Amenable to including domain knowledge, problem info
  - Is Not: Always a big data problem, deep learning + other stuff
- How NASA can engage with academia, industry in advancing ML and domains

Workshop Agenda

- Keynotes
- Machine Learning for NASA problems
  - Aeronautics
  - Earth Science
  - Space Science
  - Human Space Exploration

Workshop Agenda

- Keynotes
- Machine Learning for NASA problems
- Technologies Relevant to Machine Learning
  - Human-Machine Interaction
  - Hardware, Program Synthesis, V&V
- Breakout sessions
  - Recommendations for future work
- Path forward

Keynotes

- Peter Norvig, Director of Research, Google:
  - Practical ML, User provides problem and examples, not how to solve it; more data available---use it
- Vipin Kumar, Professor of Computer Science, University of Minnesota
  - Big Data in Climate, Using physics/Earth science knowledge to guide ML
- Nikunj Oza, Data Sciences Group Leader, NASA Ames Research Center
  - R&D in ML/DM/DS with NASA applications

Data Sciences Group led work, Data Sciences Group involved

Keynotes

- Piyush Mehrotra, HPC Infrastructure for ML
- Mike Little, Advanced Information Systems Technology (AIST), IT for Earth Science

Machine Learning for Aeronautics

- Deepak Kulkarni: Models of Weather Impact on Airspace Operations
- Heather Arneson: Analysis of Convective Weather Impact on Routing
- Bryan Matthews: Assessing RNAV STAR Adherence
- Vijay Janakiraman: Discovering Precursors to Safety Incidents

Data Sciences Group led work, Data Sciences Group involved

ML for Aeronautics Breakout

- ML for Safe UAV operations
- Explainable ML for Air Traffic Management Decision Support
- Human Performance Monitoring -> Improved policies, scheduling

Machine Learning for Space Exploration

- Shawn Wolfe: Automated Monitoring for Mission Operations
- David Thompson: Autonomous Medical Operations
- Rodney Martin: ISHM for Sustainable Habitats
- Adrian Agogino: Machine Learning for Multi-Agent Systems

Data Sciences Group led work, Data Sciences Group involved

ML for Space Exploration Breakout

- Reduce ML application learning curve
- Initially aim for non-safety critical, non-critical path applications to gain trust
- Explainability, V&V critical
- ISHM, assist humans, learn from historical operations

Machine Learning for Earth Science

- Kamalika Das: ML for Effects of Climate on Amazon Rainforests
- Sangram Ganguly: Deep Learning Models for Satellite Image Classification
- Grey Nearing (Alabama): ML to Improve physics-based hydrology models
- James MacKinnon (NASA GSFC): Deep Neural Nets for Wildfire Detection, offline and embedded
- Stefano Ermon (Stanford): Transfer Learning, Deep Learning for poverty prediction, crop yield prediction

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ML for Earth Science

- Data: Noisy, multiple spatiotemporal resolutions
- Problems: Mapping (e.g., fire, poverty), Prediction (e.g., fires, extreme weather, climate), learning from physics and data
- Distributed sensing, intelligent instruments

Machine Learning for Astrophysics/Planetary

- Hamed Valizadegan: ML for Space Science and Engineering
- Nick Kern (Berkeley): Surrogate Modeling for Cosmology
- Sean McGregor (Oregon): FDL—Deep Learning for Solar Storm Prediction
- Mark Cheung (LockMart): FDL---Data Science for Heliophysics
- Madhulika Guhathakurta (NASA HQ)---FDL Overview

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Astrophysics/Planetary Breakout

- Vetting Transiting Exoplanet Candidates: Classification, identifying relevant features
- Better Data Archives: Easier to use and access, facilitate large studies
- Frontier Development Labs (FDL)-type intensive collaborations

Hardware, Program Synthesis, V&V

- Cliff Young (Google): Tensorflow Processing Unit
- Timothy Randles (LANL): CharlieCloud containers
- Natalia Vassilieva (HP): Hardware and software choices for deep learning
- Johann Schumann: Toward synthesizing ML algorithms
- Guy Katz (Stanford): V&V of deep nets

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Hardware, etc., Breakout

- Accounting for environment: low network bandwidth, onboard computing
- Data: format, too much and too little data
- Air Traffic Control: REALLY understand it, use all relevant data
- ML algorithms: When to use which ones?
- ML for Security, Security for ML
- ML for NASA programs
- Software for ML, including V&V

Human-Machine Interaction

- Milind Tambe (USC): Human-Machine Partnership for Social Good
- Karen Myers (SRI): Learning to Help Human Problem Solvers
- Kamalika Das: Active Learning for Domain Expert Feedback for Anomaly Detection
- Alonso Vera: What Machines Need to Learn to Help Human Problem Solvers

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The Data Sciences Group at NASA Ames

Data Mining Research and Development (R&D) for application to NASA problems (Aeronautics, Earth Science, Space Exploration, Space Science)

Group Members

Ilya Avrekh
Kamalika Das, Ph.D.
Dave Iverson
Rodney Martin, Ph.D.
Bryan Matthews
Nikunj Oza, Ph.D.
John Stutz
Hamed Valizadegan, Ph.D.
+ students

Funding Sources

- Science Mission Directorate: AIST and CMAC programs
- NASA Aeronautics Research Mission Directorate- ATD, SMART-NAS, SASO Project, Seedling Fund
- NASA Engineering and Safety Center
- Ames Center Innovation Fund
- AMMOS
- Non-NASA: DARPA, DoD

Team Members are NASA Employees, Contractors, and Students.

Collaborators

- Universities: Basic research in data sciences, domains
- Industry: Data sources, baseline methods, domain expertise
- NASA: Apply basic research, develop for NASA's needs, funding programs
- Other government: funding, domain expertise, data sources

How do we get the Word Out?

DASHlink

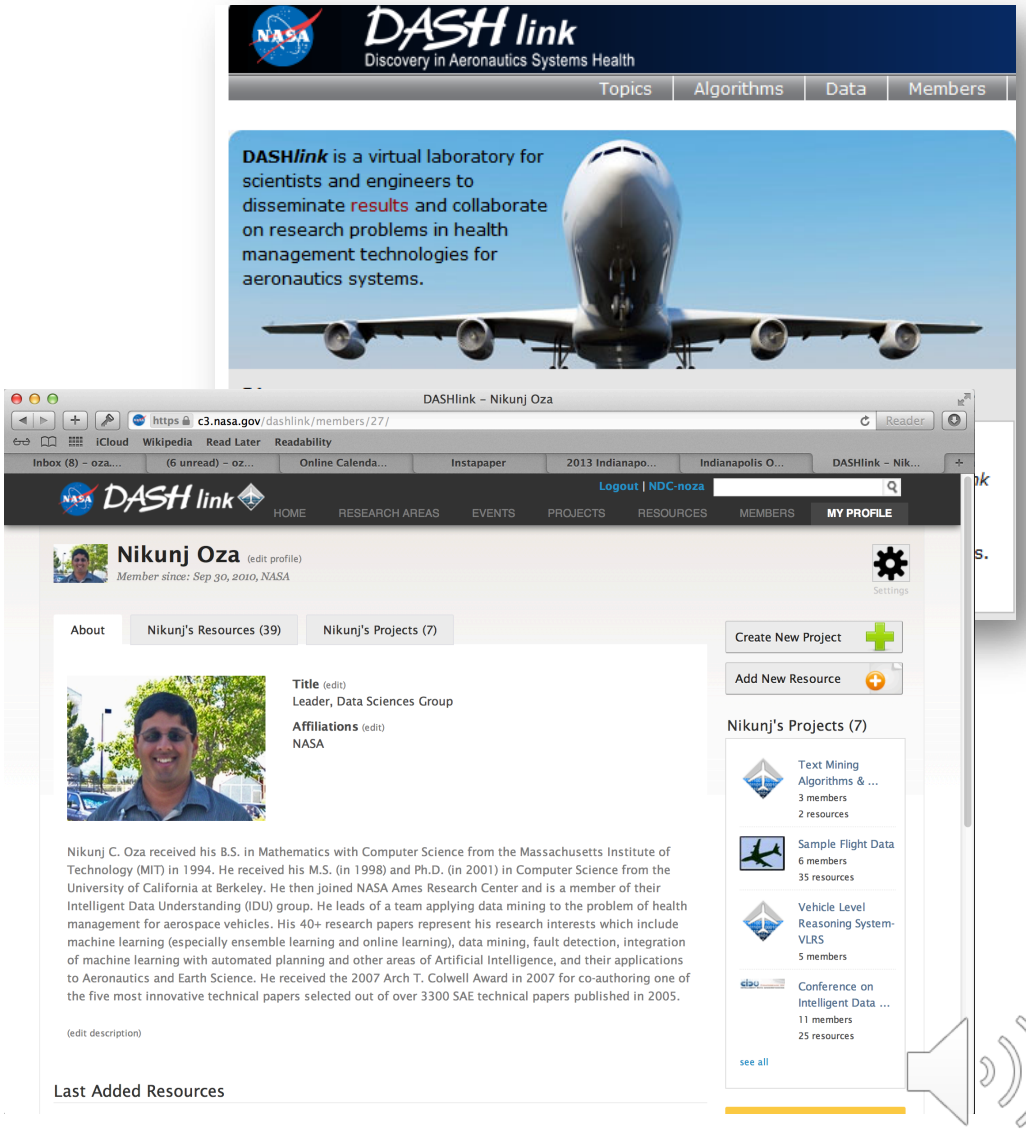
disseminate. collaborate. innovate.
https://dashlink.ndc.nasa.gov/

DASHlink is a collaborative website designed to promote:

- Sustainability
- Reproducibility
- Dissemination
- Community building

Users can create profiles

- Share papers, upload and download open source algorithms
- Find NASA data sets.

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https://ti.arc.nasa.gov/events/machinelearningworkshop2017/
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